INDOOR AIR QUALITY REASSESSMENT

A. J. Sitkowski Elementary School
29 Negus Street
Webster, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
July, 2001

Background/Introduction

At the request of Edward Kunkel, Business Administrator Webster Public Schools, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality at the A. J. Sitkowski Elementary School (AJSES), 29 Negus Street in Webster, Massachusetts. The school was previously visited on January 20, 2000 by BEHA's ER/IAQ program. A report was issued (MDPH, 2000) which described the conditions of the building at that time. The report identified problems and gave recommendations on how to correct those problems. On May 4, 2001, Cory Holmes, Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, revisited the school to conduct an indoor air quality reassessment. This reassessment followed the completion of most of those remedies previously recommended.

Actions on Previous Recommendations

BEHA had previously made 22 recommendations to improve indoor air quality. The Webster School Department (WSD) and AJSES staff had implemented many of these recommendations at the time of the reassessment (see Attachment) and these efforts should serve to improve indoor air quality in the building. The following is a status report of action(s) on BEHA recommendations based on reports from school officials, documents, photographs and BEHA staff observations.

1. **Remove carpet from interior of classroom 212 univent. Repair steam leak. Disinfect floor beneath carpet with an appropriate antimicrobial agent.**

Action 1: Steam leak was repaired, water damaged carpeting within the univent was removed. Classroom carpeting was dried out, no active mold growth or associated odors were present during the reassessment.

2. **Survey classrooms for univent function to ascertain if an adequate air supply exists for each room and make univent repairs as needed. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.**

Action 2: All univents were examined by an HVAC engineer, many repairs were made and parts were replaced (electric pneumatic relays, adjustments to ductwork, etc.). During the assessment most of the univents were operating with the exception of a few which were reportedly on a repair list waiting for replacement parts (e.g., 214, B-2, B-11).

3. **Examine unit exhaust ventilators and wall-mounted exhaust vents for proper function. Operate exhaust ventilation during occupancy. Examine rooftop exhaust motors for function. Increase exhaust airflow if necessary.**

Action 3: Rooftop motors and belts were examined by the HVAC engineer and determined to be working at full capacity. The HVAC engineer recommended making adjustments to ductwork such as adding dampers to balance the system. BEHA staff noted several areas in which exhaust was not drawing at all or was drawing weakly (see Tables)

4. **Remove all blockages from univents and exhaust vents to ensure adequate airflow.**

Action 4: Staff were instructed by the school department to remove materials obstructing airflow of univents. Adherence to this advice was apparent school-wide.

5. **Once the unit ventilator and exhaust systems are fully operational, the systems should be balanced by a ventilation engineer. Operate univents and exhaust ventilation while classrooms are occupied.**

Action 5: Ventilation system balancing is an on-going project. The BEHA recommends that the school's HVAC engineer use this, as well as the previous BEHA report as an aid to identify problem areas and schedule balancing accordingly. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

6. **Pathways for movement of particulates should be sealed with a solid material (e.g., plywood) that is rendered airtight with a caulking seal. Abandoned vents in classrooms, abandoned dumbwaiter doors, abandoned closet exhaust vents and the door to the original ventilation system equipment room should be sealed in this manner. Weather stripping or caulk can be used to seal the hatchways in the classroom coat closets.**

Action 6: Abandoned closet vents and wall mounted natural gravity feed vents were all sealed (see Pictures 1 & 2).

7. **Seal abandoned rooftop gravity exhaust vents with a water impermeable material. Repair damaged peaked covers over vents where necessary.**

Action 7: The WSD reports that the sealing of rooftop equipment was addressed at a special town meeting, which appropriated the funding to complete this project (see Attachment).

8. **For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).**

Action 8: A HEPA filtered vacuum cleaner was reportedly purchased and is in use. Efforts have been made by school maintenance personnel to improve dust control and general cleaning.

9. **Continue with plans to bring town hall HVAC system on-line, consider re-zoning thermostats to provide better control for thermal comfort.**

Action 9: School officials report that a new furnace was installed that has helped improve heating conditions in the building.

10. **Repair steam leaks in the boiler room and in the univent of classroom 212. Examine the area around the leak for mold growth and replace carpeting if moldy. Examine all univents periodically for similar leaks. Disinfect areas of water leaks with an appropriate antimicrobial if necessary.**

Action 10: Steam leak in classroom 212 univent was repaired. BEHA staff were informed that steam observed in the boiler room during the previous assessment was not a result of a leak but from periodic pressure release from steam traps.

11. **Repair roof/window leaks and replace/repair any water-stained ceiling tiles and wall plaster. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial if necessary.**

Action 11: Roof leaks were reportedly patched by the WSD's roofing contractor. No active leaks were reported or observed during the reassessment. Window leaks were reportedly addressed by a window contractor hired by the WSD.

12. **Move plants away from univents in classrooms. Ensure plants have drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary.**

Action 12: Staff were instructed by the school department to remove materials obstructing airflow of univents. Adherence to this advice was apparent school-wide.

13. **Ensure local exhaust ventilation for kiln is operating at all times kiln is in use. Do not activate univent and wall-mounted exhaust vent during kiln operation.**

Action 13: Local exhaust ventilation is reportedly operated during kiln operation.

14. **Seal floor drains in areas with unused showers. If not practical, have maintenance staff pour water into the shower drains every other day to maintain drain traps.**

Action 14: Drains were not sealed; water is regularly poured into drains by school maintenance personnel to avoid dry drain traps.

15. **Avoid the use of strong scented deodorizers in restrooms. Consider increasing exhaust ventilation if necessary.**

Action 15: No strong scented materials were noted in restrooms during the reassessment. See Action 3 regarding exhaust ventilation.

16. **Change filters for the computer room air conditioning unit as per the manufacturer's instructions, or more frequently if needed to prevent the re-aerosolization of dirt, dust and particulate matter.**

Action 16: Filters for the computer room were observed to be clean (see Picture 3) and are now changed as per the manufacturer's instructions.

17. **Seal utility holes around pipes.**

Action 17: The sealing of utility holes is an on-going project.

18. **Ensure exhaust ventilation in teacher's room is operating during photocopying and lamination activities to remove excess heat and odors. Consider moving equipment closer to the wall-mounted exhaust vent.**

Action 18: Exhaust ventilation operates continuously during hours of school occupation.

19. **Clean chalkboards and trays regularly to prevent the build-up of excessive chalk dust.**

Action 19: Conditions in most classrooms were improved, however several areas continue to have accumulated chalk dust in trays (see Picture 4).

20. Store the snow blower in an area with adequate ventilation that will prevent VOC migration into occupied areas.

Action 20: The snow blower was relocated and reportedly stored in a vented building off school grounds.

21. Examine options for repairing the steam leak in the boiler room.

See Response/Action 10.

22. Have trash pick up after school hours to prevent vehicle exhaust entrainment into classrooms.

Action 21: Trash pick-up is reportedly conducted three times a week before or after school hours.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551.

Results

The school has a student population of approximately 580 and a staff of approximately 80. The tests were taken during normal operations at the school. Test results appear in Tables 1-5.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million of air (ppm) in six of forty-three areas surveyed, which is a significant improvement since the previous assessment. These carbon dioxide levels indicate adequate air exchange in most areas of the school. It is important to note however, that most of the classrooms had open windows, which can greatly reduce carbon dioxide levels.

Fresh air in classrooms is supplied by a unit ventilator (univent) system (see Figure 1). As stated previously, univents were functioning in most classrooms surveyed, with the exception of those awaiting repairs. As with the univents, unit exhaust ventilators were operating in all classrooms with one or two exceptions (see Tables).

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches.

The assessment took place on a day of unseasonably warm weather. The AJSES is not equipped with air conditioning; operation of univents introduces unconditioned outside air only. Temperature readings ranged from 76^{o} F to 86^{o}, which was above the BEHA recommended comfort guidelines in a number of areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity was measured in a range of 33 to 43 percent, which was below the BEHA recommended comfort range in some areas sampled. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Other Concerns

Petroleum odors were noted in the basement hallway outside of mechanical room B-4. The door to this area is a metal/mesh type to allow airflow into the mechanical room (see Picture 5). Oil stains and an absorbent material were noted in this area (see Picture 6). Petroleum products can be a source of unpleasant odors and contain volatile organic compounds (VOCs) which can be irritating to the eyes, nose and throat.

Conclusions/Recommendations

The WSD, working in conjunction with AJSES staff has improved overall indoor air quality at the school by implementing many of the BEHA's previous recommendations. In view of the findings at the time of this visit, the following recommendations are made to further improve indoor air quality:

1. Continue with repairs/adjustments to the school's ventilation components. Once complete consider having the systems balanced by an HVAC engineering firm.
2. Consult with HVAC engineer on how to improve exhaust capabilities in areas with weak/non-functioning exhaust vents.
3. Continue to implement improved dust control methods such as wet wiping and HEPA vacuuming.
4. Clean mechanical room of saturated absorbent material and clean up oil stains/spills. Discard of hazardous materials in a manner consistent with environmental statutes and regulations. Consider replacing door with a solid, airtight door to prevent the migration of fuel odors. Note: doors should be in

compliance with local/state fire code. If door replacement is not feasible, consider installing local exhaust fan to place the mechanical room under negative pressure.

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1
York, NY.

MDPH. 2000. Indoor Air Quality Assessment. A. J. Sitkowski Elementary School, Webster, MA. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA. March, 2000.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

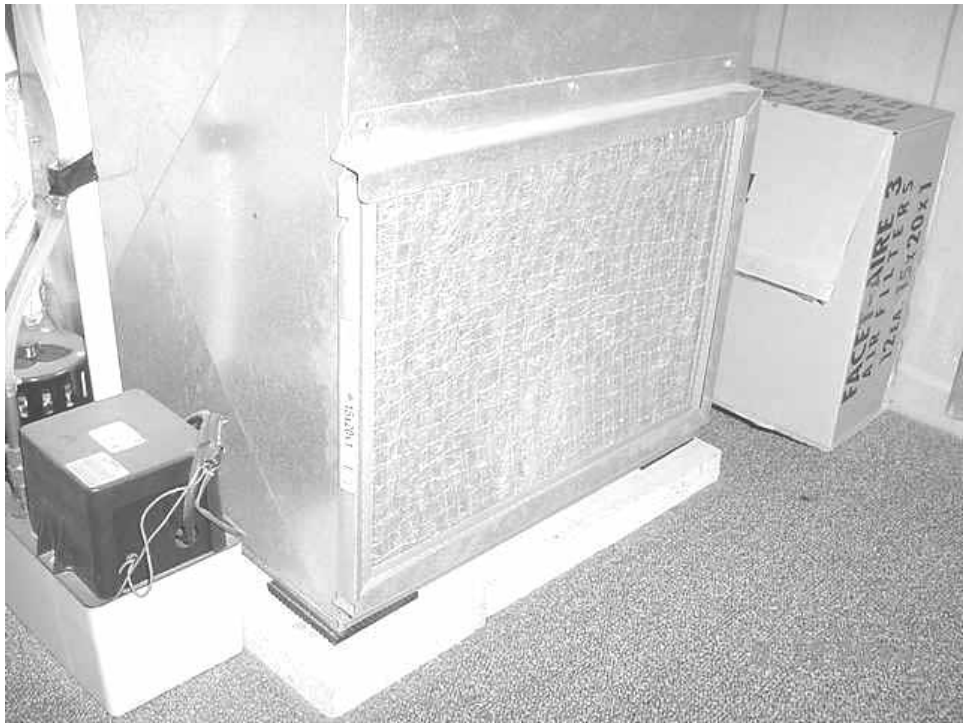
Picture 1

Sealed Abandoned Coat Closet Exhaust Vent

Picture 2

Sealed Abandoned Natural Gravity Vent in Classroom

Picture 3



Filter for AHU in Computer Room

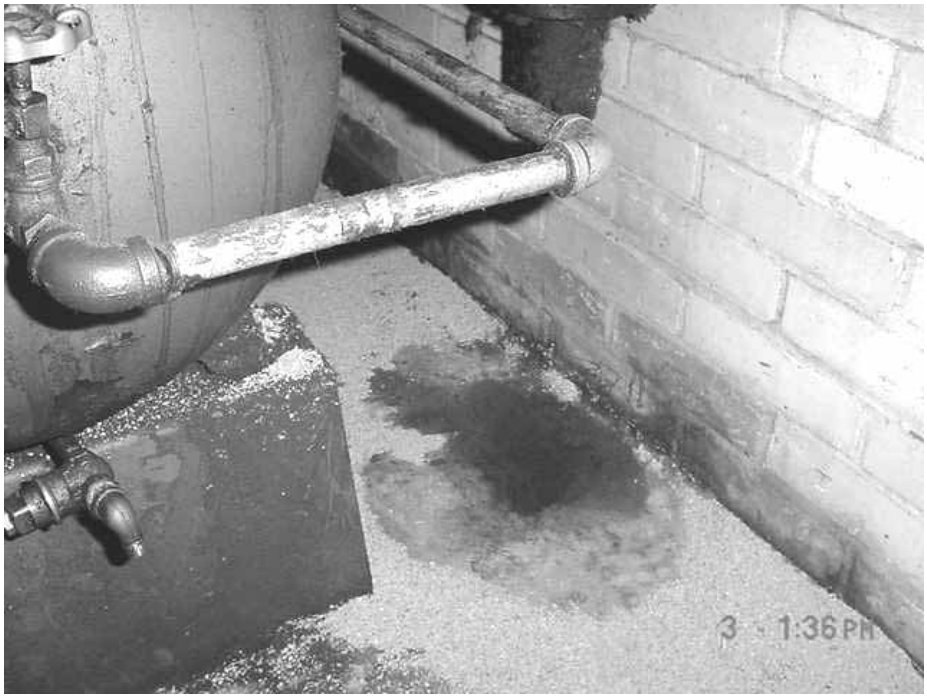
Picture 4

Accuumulated Chalk Dust in Classroom

Picture 5

Mechanical Room Door (B-4)

Picture 6



Oil Stains and Absorbant Material in Mechanical Room (B-4)

TABLE 1

Indoor Air Test Results –A. J. Sitkowski Elementary School, Webster, MA – May 4, 2001

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	457	83	41					
Room 302	763	85	35	6	yes	yes	yes	Window open
Room 304	792	84	35	4	yes	yes	yes	Window open
Teacher's Room	737	85	35	3	Yes	yes	yes	Window open
Room 308	1053	85	39	22	yes	yes	yes	
Art Room (310)	486	85	33	1	yes	yes	yes	
Room 216	671	86	36	6	yes	yes	yes	Window open
Room 214	531	84	35	6	yes	yes	yes	Univent not operational-mechanical problem
Room 212	589	83	37	6	yes	yes	yes	Window open
Room 221	503	83	34	0	Yes	Yes	Yes	Window open, chalk dust
Room 210 (Library)	515	81	39	0	yes	no	yes	Window open

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results –A. J. Sitkowski Elementary School, Webster, MA – May 4, 2001

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Computer Room (206)	587	79	33	0	yes	yes	no	dirt/dust on univent-from utility hole on ceiling
Room 202	637	82	37	3	yes	yes	yes	Window open, chalk dust
Room 101	501	82	35	0	yes	yes	yes	
Room 105	704	80	38	20	yes	yes	yes	
Room 119	785	81	40	20	yes	no	no	Window open, open vent
Room B-11	614	77	36	5	yes	yes	no	Window open, univent on repair list
Room B-2	853	77	42	10	yes	yes	no	Univent not operational-electrical problem-on repair list
B-4 Mechanical Room								Oil/fuel odors, speedi-dry (oil leak), odors in basement hallway
Room 211	539	82	37	22	yes	yes	yes	Window open
Room 205	532	83	34	21	yes	yes	yes	
Room 203	687	82	37	20	yes	yes	yes	One window reportedly unopenable

*** ppm = parts per million parts of air**
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Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
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	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results –A. J. Sitkowski Elementary School, Webster, MA – May 4, 2001

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 201	480	81	35	0	yes	yes	yes	
Room 102	766	82	38	17	yes	yes	yes	
Room 104	617	82	38	0	yes	yes	yes	Window open
Room 108	515	81	40	0	yes	yes	yes	
Room 301	641	84	34	10	yes	yes	yes	Exhaust not drawing
Room 305	703	85	34	22	yes	yes	yes	Window open
Cafeteria	600	82	40	~190	yes	yes (2)	yes	Window open
Room 311	595	83	33	22	yes	yes	yes	Window open
Room 313	612	84	34	18	yes	yes	yes	Window open
Room 315	675	85	33	23	yes	yes	yes	Window open
Room 217	578	84	34	4	yes	no	no	Window open

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results –A. J. Sitkowski Elementary School, Webster, MA – May 4, 2001

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 110	617	81	39	8	yes	no	no	Window open, no mechanical ventilation
Nurse's Office	792	81	39	2	yes	no	no	
Main Office	650	79	43	5	Yes	No	No	Window open, window mounted A/C
Room B-8	1289	76	37	1	no	no	no	No mechanical ventilation
Room B-2B	612	77	41	1	yes	no	no	Window open, passive door vent
Music Room	822	77	34	21	yes	Yes		
Room 122	620	83	39	11	Yes	Yes	Yes	Window open
Room 117	871	81	39	24	Yes	Yes	Yes	Window open
Room 115	1367	81	39	19	Yes	Yes	Yes	
Room 103	680	82	38	18	Yes	Yes	Yes	Window open
Guidance	607	79	38	0	No	No	No	

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide - < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems
Temperature - 70 - 78 °F
Relative Humidity - 40 - 60%

TABLE 5

Indoor Air Test Results –A. J. Sitkowski Elementary School, Webster, MA – May 4, 2001

Remarks	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Room 215	549	81	35	3	Yes	No	No	Window open

*** ppm = parts per million parts of air**
CT = water-damaged ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Attachment

WEBSTER PUBLIC SCHOOLS

Administrative Office - Filmer School

Ted Avlas
Chairman
Diane Comeau
Vice Chairman
Charles Cormier
Michael Makara
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BETTER SCHOOLS BETTER COMMUNITY

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April 18, 2001

Michael A. Feeney
Department of Public Health
250 Washington Street 7th Floor
Boston, MA 02108-4619

Re: Air Quality RE-TEST

Dear Mr. Feeney:

On January 20, 2000, your Department tested the Anthony J. Sitkowski School for air quality issues. As a result of that evaluation, twenty-two recommendations were brought forward to the Webster School District to improve Air Quality in that building.

We are pleased to inform you, that of the issues cited in your report, the only outstanding issue remaining is the sealing of the roof top cavity units. These units have been abandoned for several years, and serve no useful function. A special town Meeting was held on April 9, 2001, that appropriated funding to seal those units, and plans are underway to complete this project.

My request of your department at this time would be to re-test the building, in order to evaluate any progress that has been made since the last testing took place. This is a very important issue to the building occupants, and parents of our students. If further action has to be taken we would take appropriate strategy to remedy any problems.

Your immediate attention to this matter is greatly appreciated.

Very truly yours,

Edward S. Kunkel, Jr.
Business Administrator